

SIEMENS

Test Document

Report-No.: HBA 09149 P

Content : 19 Sheets

Apparatus tested : Metal oxide surge arresters, nominal discharge current 10 kA and 20 kA.

Type: 3EP2	3EP3	3EP4
3EQ1	3EQ4	3EQ3

Date of Test : April 1997 and December 1998

Testing Station : Siemens AG, Arrester Test Field

Applied Test Specifications :

IEC Publ. 99-4, (1991)

IEEE Std C62.11 - 1993

NEMA Pub. No.107 - 1987

NEMA Pub. No.LA 1 - 1992

Test performed :

Radio influence voltage test

Internal ionisation voltage test

Test Result :

The test objects have passed the tests stated above without any objection.

The results obtained and the performance proved of the test objects comply with the requirements of the specifications mentioned above.

Siemens Aktiengesellschaft
PTD H 4

sign Dr. Steinfeld

(Dr. K. Steinfeld)
(Director R&D)

sign Schubert

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(Head of Arrester Test Field)

Berlin, March 19th, 2002

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Type 3EP2 ...-1..1.-....

Maximum rated voltage	210 kV
Maximum continuous operating voltage	168 kV
Nominal discharge current	10 kA
Long duration current impulse capability	500 A / 2 ms
Line discharge class	1
Thermal energy discharge capability	3.5 kJ / kV _{rated}
Single impulse energy discharge capability (>4 ms)	2.5 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP2 ...-1..2.-....

Maximum rated voltage	240 kV
Maximum continuous operating voltage	192 kV
Nominal discharge current	10 kA
Long duration current impulse capability	500 A / 2 ms
Line discharge class	2
Thermal energy discharge capability	5 kJ / kV _{rated}
Single impulse energy discharge capability (>4 ms)	2.6 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP2 ...-1..3.-....

Maximum rated voltage	240 kV
Maximum continuous operating voltage	192 kV
Nominal discharge current	10 kA
Long duration current impulse capability	500 A / 2 ms
Line discharge class	3
Thermal energy discharge capability	5.5 kJ / kV _{rated}
Single impulse energy discharge capability (>4 ms)	3 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP2 ...-2..2.-....

Maximum rated voltage	360 kV
Maximum continuous operating voltage	288 kV
Nominal discharge current	10 kA
Long duration current impulse capability	850 A / 2 ms
Line discharge class	2
Energy discharge capability	5 kJ / kV _{rated}
Single impulse discharge capability	3.8 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP2 ...-2..3.-....

Maximum rated voltage	360 kV
Maximum continuous operating voltage	288 kV
Nominal discharge current	10 kA
Long duration current impulse capability	850 A / 2 ms
Line discharge class	3
Energy discharge capability	8 kJ / kV _{rated}
Single impulse discharge capability	4 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP2 ...-3..3.-....

Maximum rated voltage	396 kV
Maximum continuous operating voltage	301 kV
Nominal discharge current	20 kA
Long duration current impulse capability	1200 A / 2 ms
Line discharge class	3
Energy discharge capability	8 kJ / kV _{rated}
Single impulse discharge capability	5.3 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP2 ...-3..4.-....

Maximum rated voltage	468 kV
Maximum continuous operating voltage	374 kV
Nominal discharge current	20 kA
Long duration current impulse capability	1200 A / 2 ms
Line discharge class	4
Energy discharge capability	10 kJ / kV _{rated}
Single impulse discharge capability	5.6 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP2 ...-4..5.-....

Maximum rated voltage	468 kV
Maximum continuous operating voltage	374 kV
Nominal discharge current	20 kA
Long duration current impulse capability	1600 A / 2 ms
Line discharge class	5
Energy discharge capability	13 kJ / kV _{rated}
Single impulse discharge capability	7.8 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP3 ...-2..2.-....

Maximum rated voltage	360 kV
Maximum continuous operating voltage	288 kV
Nominal discharge current	10 kA
Long duration current impulse capability	850 A / 2 ms
Line discharge class	2
Energy discharge capability	5 kJ / kV _{rated}
Single impulse discharge capability	3.8 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP3 ...-2..3.-....

Maximum rated voltage	360 kV
Maximum continuous operating voltage	288 kV
Nominal discharge current	10 kA
Long duration current impulse capability	850 A / 2 ms
Line discharge class	3
Energy discharge capability	8 kJ / kV _{rated}
Single impulse discharge capability	4 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP3 ...-3..3.-....

Maximum rated voltage	396 kV
Maximum continuous operating voltage	301 kV
Nominal discharge current	20 kA
Long duration current impulse capability	1200 A / 2 ms
Line discharge class	3
Energy discharge capability	8 kJ / kV _{rated}
Single impulse discharge capability	5.3 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP3 ...-3..4.-....

Maximum rated voltage	468 kV
Maximum continuous operating voltage	374 kV
Nominal discharge current	20 kA
Long duration current impulse capability	1200 A / 2 ms
Line discharge class	4
Energy discharge capability	10 kJ / kV _{rated}
Single impulse discharge capability	5.6 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP3 ...-4..5.-....

Maximum rated voltage	612 kV
Maximum continuous operating voltage	489 kV
Nominal discharge current	20 kA
Long duration current impulse capability	1600 A / 2 ms
Line discharge class	5
Energy discharge capability	13 kJ / kV _{rated}
Single impulse discharge capability	7.8 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP3 ...-5..5.-....

Maximum rated voltage	612 kV
Maximum continuous operating voltage	489 kV
Nominal discharge current	20 kA
Long duration current impulse capability	2100 A / 2 ms
Line discharge class	5
Energy discharge capability	15 kJ / kV _{rated}
Single impulse discharge capability	9.5 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP4 ...-1..1.-....

Maximum rated voltage	156 kV
Maximum continuous operating voltage	124 kV
Nominal discharge current	10 kA
Long duration current impulse capability	500 A / 2 ms
Line discharge class	1
Energy discharge capability	3.5 kJ / kV _{rated}
Single impulse discharge capability	2.5 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP4 ...-1..2.-....

Maximum rated voltage	147 kV
Maximum continuous operating voltage	117 kV
Nominal discharge current	10 kA
Long duration current impulse capability	500 A / 2 ms
Line discharge class	2
Energy discharge capability	5 kJ / kV _{rated}
Single impulse discharge capability	2.6 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP4 ...-1..3.-....

Maximum rated voltage	129 kV
Maximum continuous operating voltage	103 kV
Nominal discharge current	10 kA
Long duration current impulse capability	500 A / 2 ms
Line discharge class	3
Energy discharge capability	5.5 kJ / kV _{rated}
Single impulse discharge capability	3 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP4 ...-2..2.-....

Maximum rated voltage	156 kV
Maximum continuous operating voltage	124 kV
Nominal discharge current	10 kA
Long duration current impulse capability	850 A / 2 ms
Line discharge class	2
Energy discharge capability	5 kJ / kV _{rated}
Single impulse discharge capability	3.8 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EP4 ...-2..3.-....

Maximum rated voltage	147 kV
Maximum continuous operating voltage	117 kV
Nominal discharge current	10 kA
Long duration current impulse capability	850 A / 2 ms
Line discharge class	3
Energy discharge capability	8 kJ / kV _{rated}
Single impulse discharge capability	4 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ1 ...-1..1.-....

Maximum rated voltage	210 kV
Maximum continuous operating voltage	168 kV
Nominal discharge current	10 kA
Long duration current impulse capability	500 A / 2 ms
Line discharge class	1
Energy discharge capability	3.5 kJ / kV _{rated}
Single impulse discharge capability	2.5 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ1 ...-1..2.-....

Maximum rated voltage	240 kV
Maximum continuous operating voltage	192 kV
Nominal discharge current	10 kA
Long duration current impulse capability	500 A / 2 ms
Line discharge class	2
Energy discharge capability	5 kJ / kV _{rated}
Single impulse discharge capability	2.6 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ1 ...-1..3.-....

Maximum rated voltage	240 kV
Maximum continuous operating voltage	192 kV
Nominal discharge current	10 kA
Long duration current impulse capability	500 A / 2 ms
Line discharge class	3
Energy discharge capability	5.5 kJ / kV _{rated}
Single impulse discharge capability	3 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ1 ...-2..2.-....

Maximum rated voltage	240 kV
Maximum continuous operating voltage	192 kV
Nominal discharge current	10 kA
Long duration current impulse capability	850 A / 2 ms
Line discharge class	2
Energy discharge capability	5 kJ / kV _{rated}
Single impulse discharge capability	3.8 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ1 ...-2..3.-....

Maximum rated voltage	240 kV
Maximum continuous operating voltage	192 kV
Nominal discharge current	10 kA
Long duration current impulse capability	850 A / 2 ms
Line discharge class	3
Energy discharge capability	8 kJ / kV _{rated}
Single impulse discharge capability	4 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ4 ...-1..1.-....

Maximum rated voltage	210 kV
Maximum continuous operating voltage	168 kV
Nominal discharge current	10 kA
Long duration current impulse capability	500 A / 2 ms
Line discharge class	1
Energy discharge capability	3.5 kJ / kV _{rated}
Single impulse discharge capability	2.5 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ4 ...-1..2.-....

Maximum rated voltage	240 kV
Maximum continuous operating voltage	192 kV
Nominal discharge current	10 kA
Long duration current impulse capability	500 A / 2 ms
Line discharge class	2
Energy discharge capability	5 kJ / kV _{rated}
Single impulse discharge capability	2.6 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ4 ...-1..3.-....

Maximum rated voltage	240 kV
Maximum continuous operating voltage	192 kV
Nominal discharge current	10 kA
Long duration current impulse capability	500 A / 2 ms
Line discharge class	3
Energy discharge capability	5.5 kJ / kV _{rated}
Single impulse discharge capability	3 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ4 ...-2..2.-....

Maximum rated voltage	360 kV
Maximum continuous operating voltage	288 kV
Nominal discharge current	10 kA
Long duration current impulse capability	850 A / 2 ms
Line discharge class	2
Energy discharge capability	5 kJ / kV _{rated}
Single impulse discharge capability	3.8 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ4 ...-2..3.-....

Maximum rated voltage	360 kV
Maximum continuous operating voltage	288 kV
Nominal discharge current	10 kA
Long duration current impulse capability	850 A / 2 ms
Line discharge class	3
Energy discharge capability	8 kJ / kV _{rated}
Single impulse discharge capability	4 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ4 ...-3..3.-....

Maximum rated voltage	396 kV
Maximum continuous operating voltage	301 kV
Nominal discharge current	20 kA
Long duration current impulse capability	1200 A / 2 ms
Line discharge class	3
Energy discharge capability	8 kJ / kV _{rated}
Single impulse discharge capability	5.3 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ4 ...-3..4.-....

Maximum rated voltage	444 kV
Maximum continuous operating voltage	355 kV
Nominal discharge current	20 kA
Long duration current impulse capability	1200 A / 2 ms
Line discharge class	4
Energy discharge capability	10 kJ / kV _{rated}
Single impulse discharge capability	5.6 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ4 ...-4..5.-....

Maximum rated voltage	468 kV
Maximum continuous operating voltage	374 kV
Nominal discharge current	20 kA
Long duration current impulse capability	1600 A / 2 ms
Line discharge class	5
Energy discharge capability	13 kJ / kV _{rated}
Single impulse discharge capability	7.8 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ3 ...-3..3.-....

Maximum rated voltage	396 kV
Maximum continuous operating voltage	301 kV
Nominal discharge current	20 kA
Long duration current impulse capability	1200 A / 2 ms
Line discharge class	3
Energy discharge capability	8 kJ / kV _{rated}
Single impulse discharge capability	5.3 kJ / kV _{rated}
High current impulse capability	100 kA

Type 3EQ3 ...-3..4.-....

Maximum rated voltage	468 kV
Maximum continuous operating voltage	374 kV
Nominal discharge current	20 kA
Long duration current impulse capability	1200 A / 2 ms
Line discharge class	4
Energy discharge capability	10 kJ / kV _{rated}
Single impulse discharge capability	5.6 kJ / kV _{rated}
High current impulse capability	100 kA

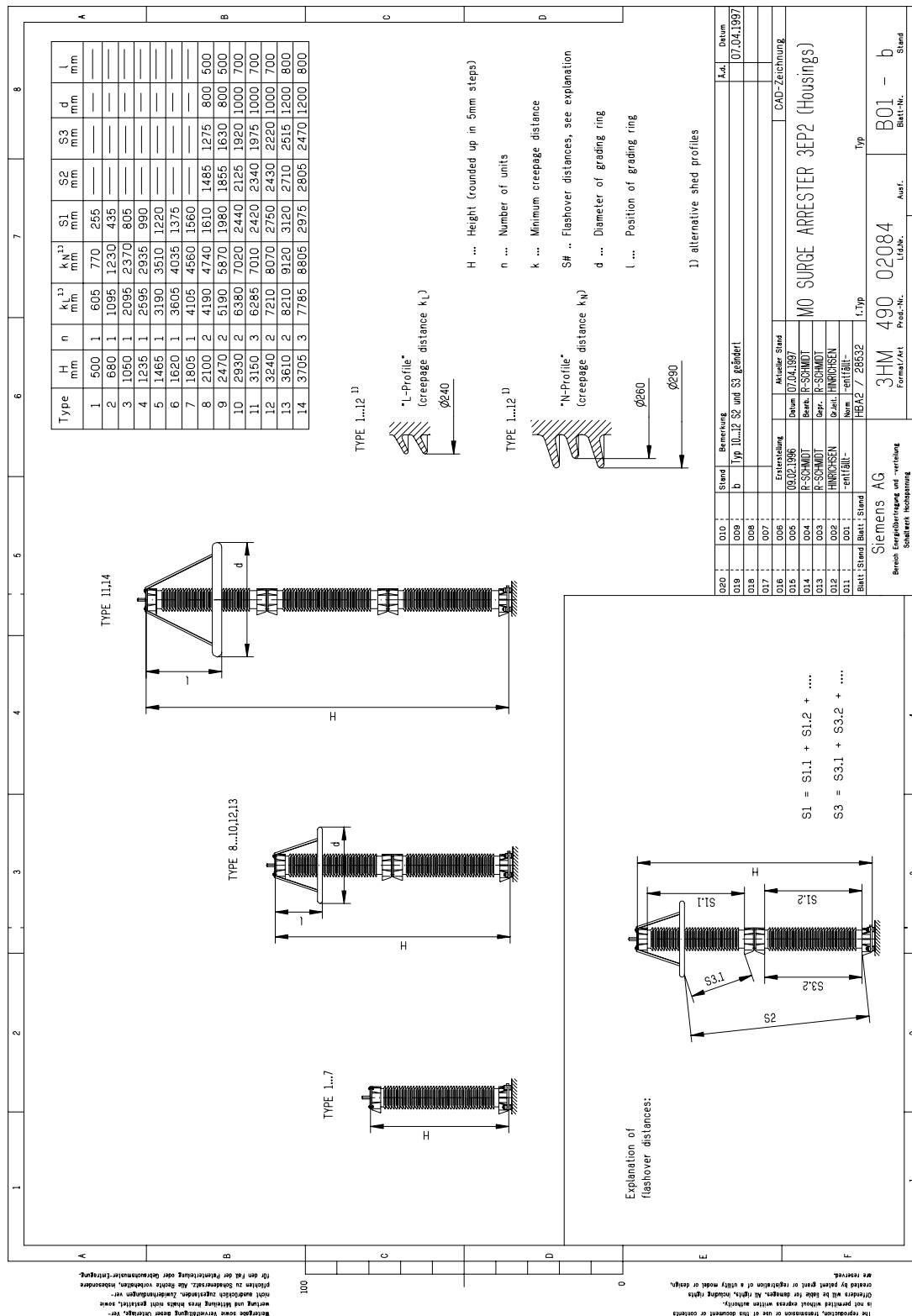
Type 3EQ3 ...-4..5.-....

Maximum rated voltage	612 kV
Maximum continuous operating voltage	489 kV
Nominal discharge current	20 kA
Long duration current impulse capability	1600 A / 2 ms
Line discharge class	5
Energy discharge capability	13 kJ / kV _{rated}
Single impulse discharge capability	7.8 kJ / kV _{rated}
High current impulse capability	100 kA

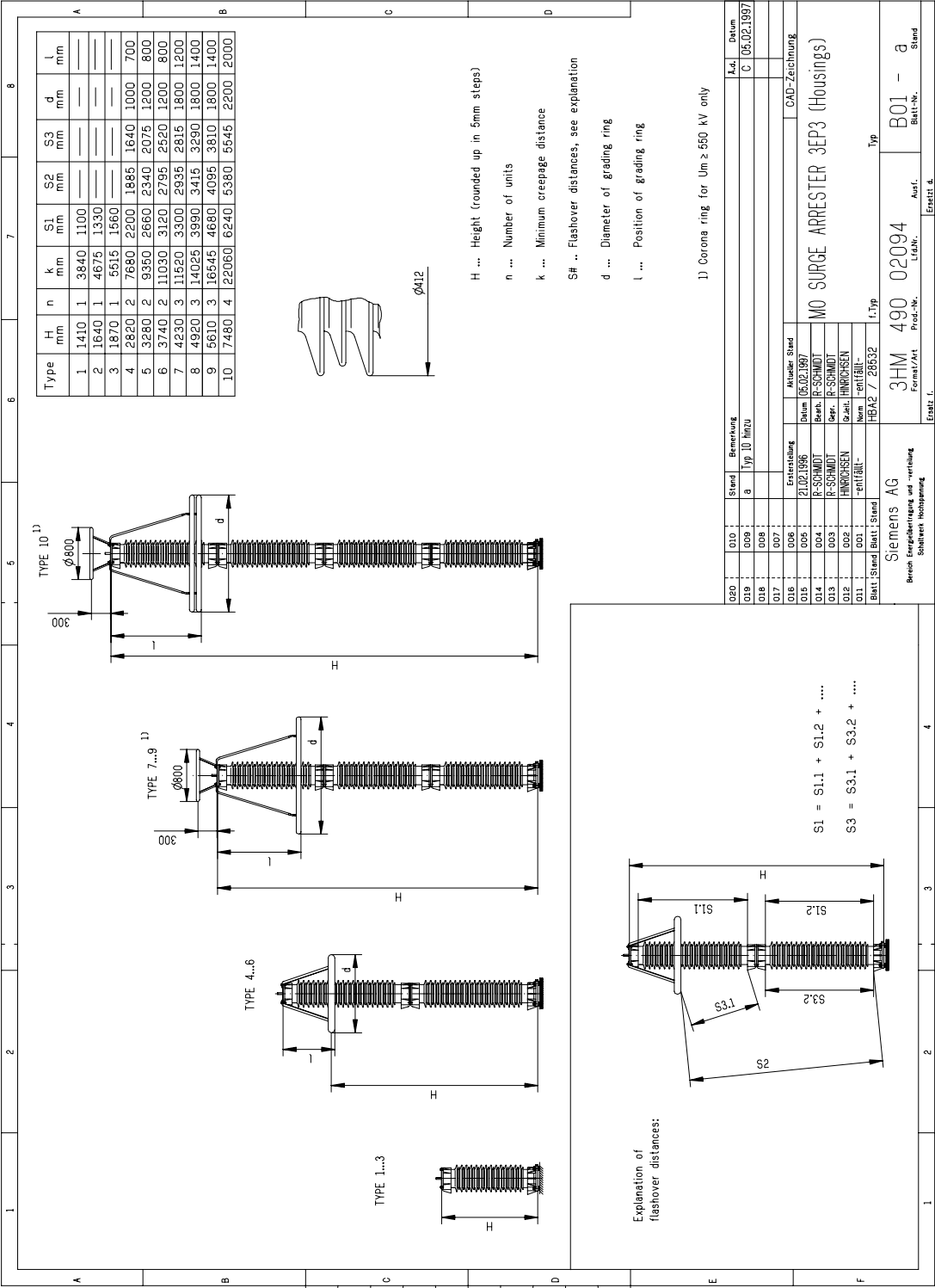
Type 3EQ3 ...-5..5.-....

Maximum rated voltage	612 kV
Maximum continuous operating voltage	489 kV
Nominal discharge current	20 kA
Long duration current impulse capability	2100 A / 2 ms
Line discharge class	5
Energy discharge capability	15 kJ / kV _{rated}
Single impulse discharge capability	9.5 kJ / kV _{rated}
High current impulse capability	100 kA

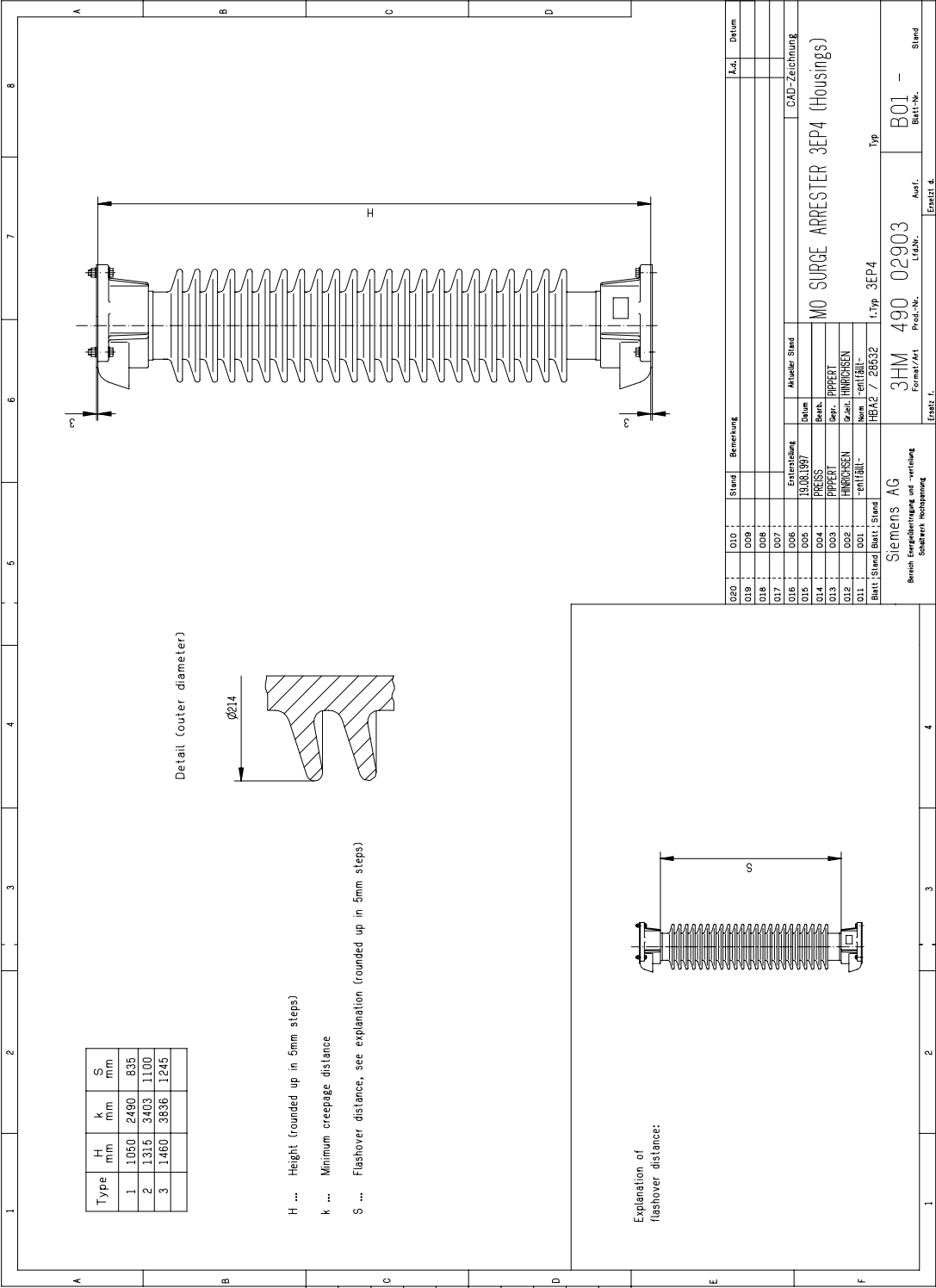
Dimensional Drawing Type 3EP2



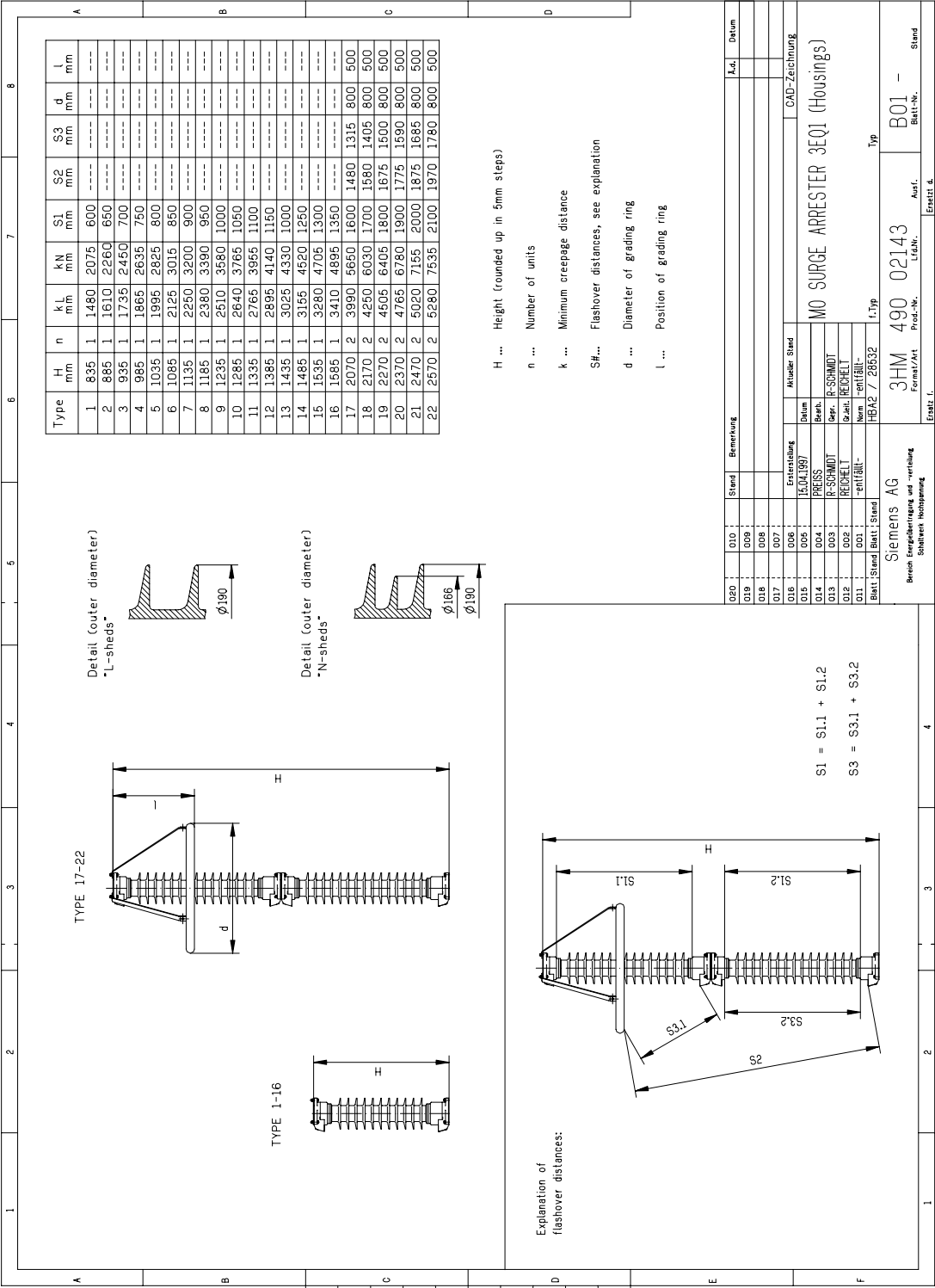
Dimensional Drawing Type 3EP3



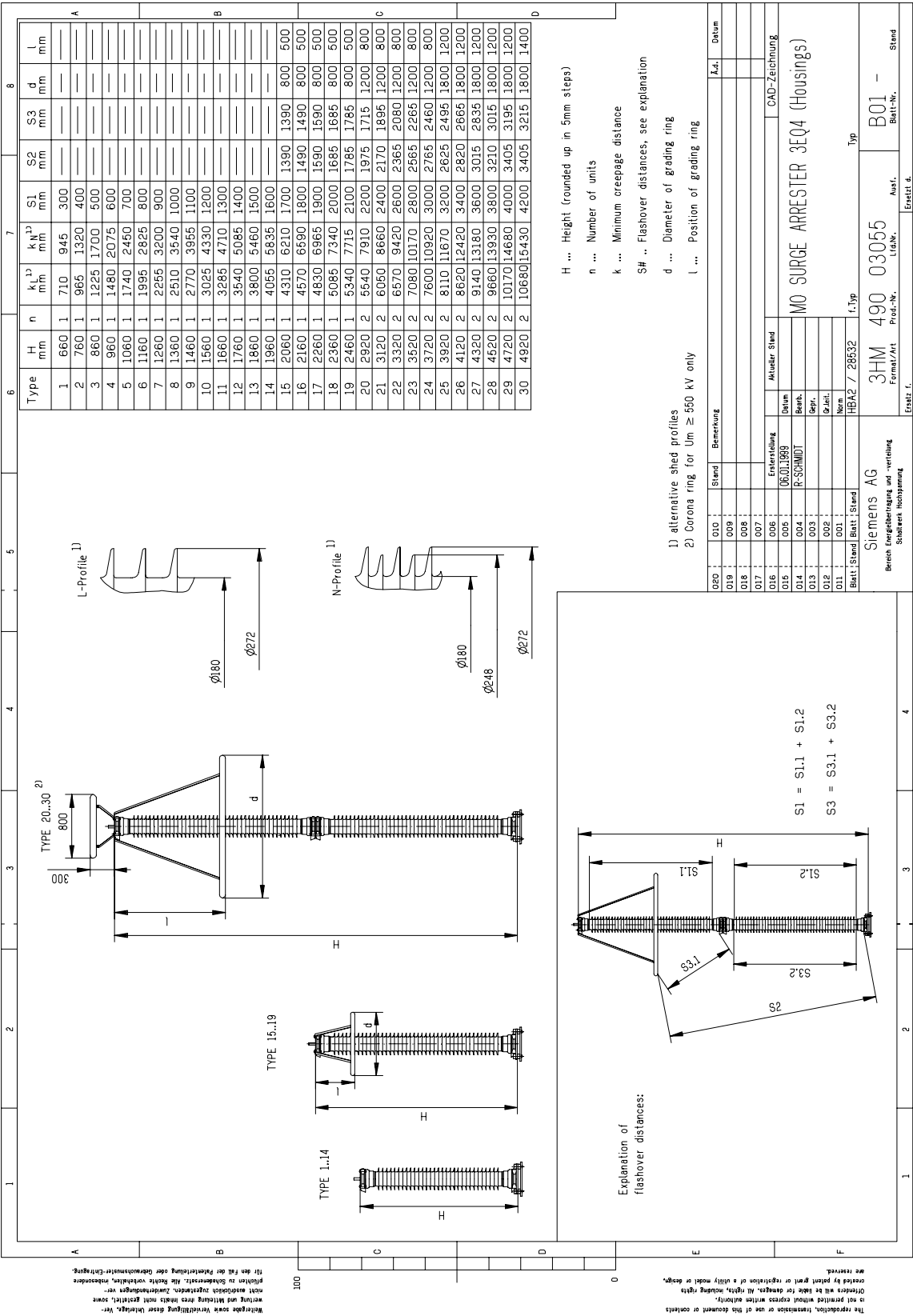
Dimensional Drawing Type 3EP4



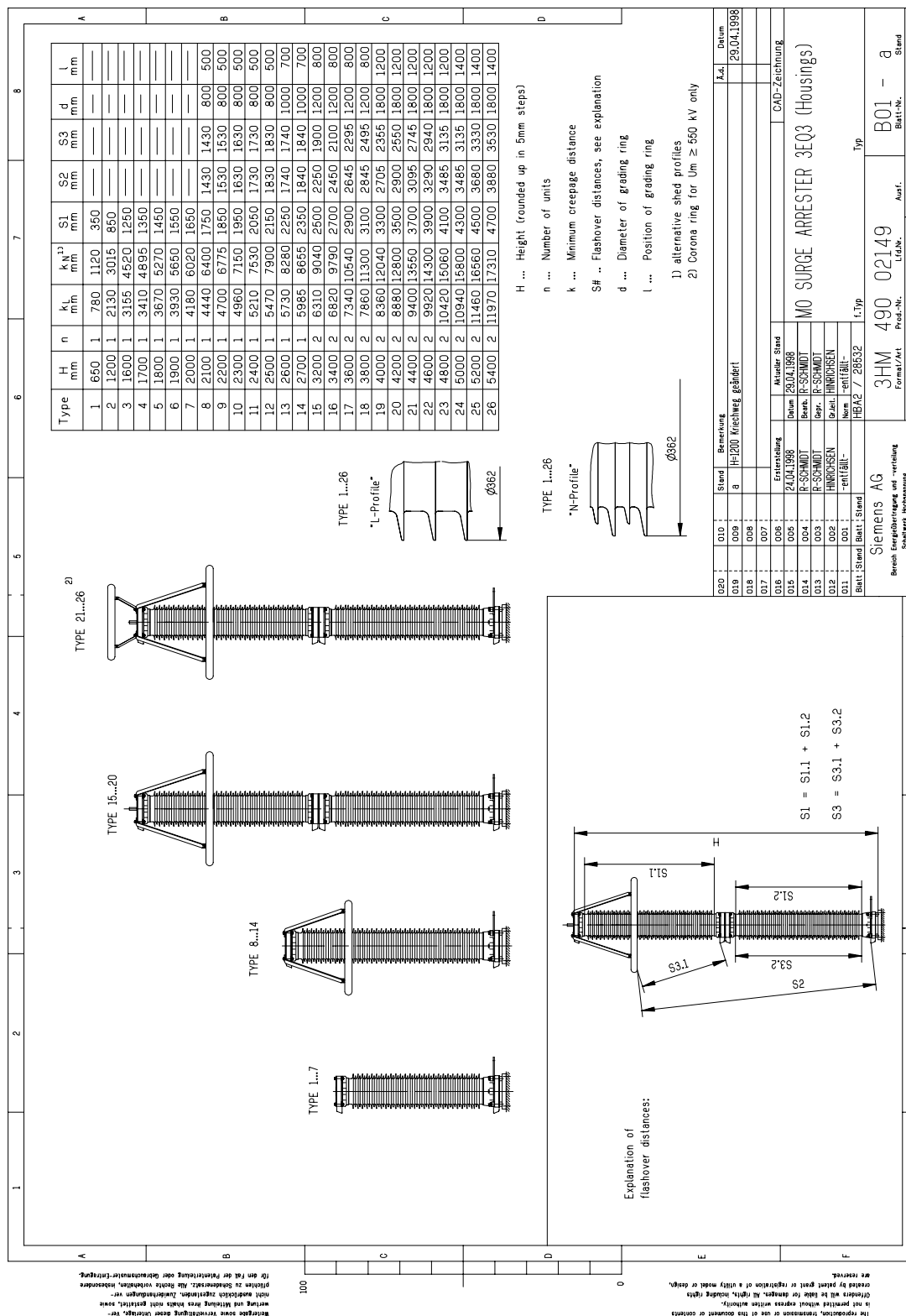
Dimensional Drawing Type 3EQ1



Dimensional Drawing Type 3EQ4



Dimensional Drawing Type 3EQ3



Radio influence / internal ionization voltage tests

The maximum radio influence and internal ionization voltage levels are given in the table below.

Arrester's Maximum Rated Voltage [kV]	Arrester's Maximum Continuous Operating Voltage [kV]	Maximum Radio Influence Voltage [μV]		Maximum Internal Ionization Voltage [μV]	
		required acc. to NEMA ¹⁾	specif. for Siemens arresters	required acc. to NEMA ¹⁾	specif. for Siemens arresters
24	19	100	25	25	2
39	31	150	25	25	2
72	57	250	25	50	2
123	98	500	50	75	2
192	152	1000	100	125	4
294	235	1500	200	200	7.5
444	352	-	250	-	20

1) NEMA Pub. LA 1 - 1992

A radio influence voltage test and an internal ionization voltage test (test circuits see sheet-nos 21) were performed according to NEMA on 12 complete arresters of different types. The arresters were assembled on a support of 2.2 m height. The RIV- resp. IIV-levels were measured at a test voltage of 1.05 times the continuous operating voltage of the arresters and a measuring frequency of 1 MHz. For the IIV-test the high voltage terminals of the test samples were shielded.

The sensitivity of the measuring system was 0.4 μV on an impedance of 60 Ω in the earth line of the coupling capacitor (0.4 μV on 60 Ω ≡ 0 dB ≡ 1.1 pC). The ground noise level was below the measuring sensitivity. The measuring system was calibrated with a pulse generator.

Test Result

The RIV- / IIV-levels X dB measured on the 60 - Ω - impedance was converted to μV on 150 - Ω - impedance according to the following equation:

$$U_{RIV / IIV} = 10^{X / 20}$$

Arrester Type	Arrester's Rated Voltage [kV]	Housing Type ³⁾	Test Voltage ²⁾ [kV]	RIV [dB]	RIV [μV]	IIV [dB]	IIV [μV]
3EQ1 150-2PN2	150	15	126	18	8	<0	<1
3EP4 156-2PN2	156	3	130	19	9	<0	<1
3EP2 180-3PN3	180	7	144	23	14	<0	<1
3EQ4 195-3PN3	195	14	156	24	16	<0	<1
3EP3 213-3PN3	213	3	170	25	18	<0	<1
3EQ3 213-3PN3	213	7	170	23	14	<0	<1
3EP2 360-3PN3	360	12	288	28	25	22	13
3EQ4 396-3PN3	396	30	316	29	28	22	13
3EP3 402-3PN3	402	6	321	30	32	23	14
3EQ3 468-3PN4	468	26	393	36	63	27	22
3EP3 468-3PN4	468	8	393	38	79	28	25

2) Test voltage = 1.05 • Continuous operating voltage

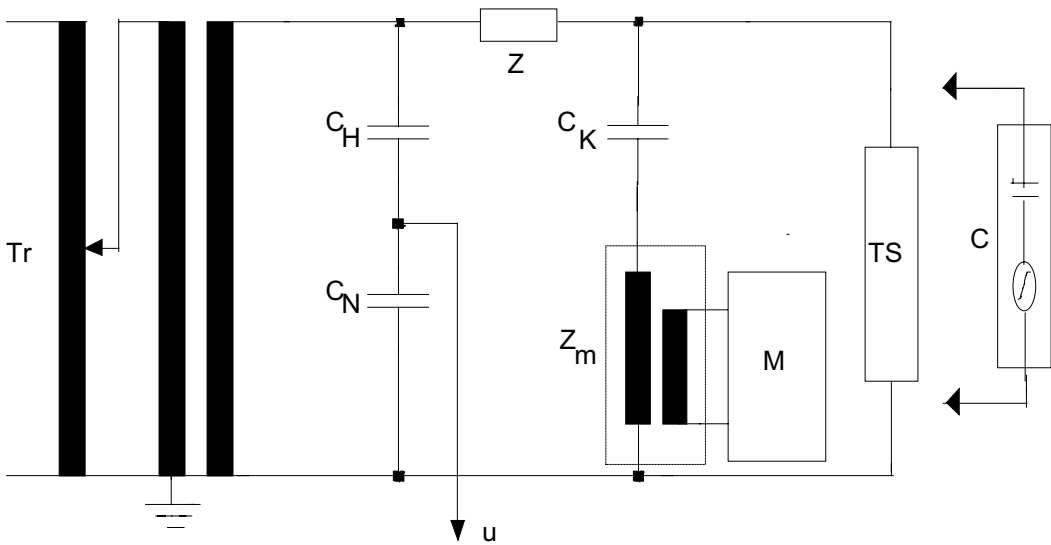
3) acc. to dimensional drawings sheet-nos. 13-19

All measured RIV- resp. IIV-values were within the specified values in the table above.

Technical Data of Test Circuit

Radio influence voltage test
Internal ionization voltage test

Transformer :	Rated voltage	kV	1200
	Rated power	kVA	1500



Tr..... Transformer
TS.... Test sample
Z..... Filter

C _K ...	Coupling capacitor	C _K = 1 nF
Z _m ...	Measuring impedance	Siemens STAV 3856a
M.....	Measuring instrument	Siemens B 83600-B40
C.....	Kalibrier-Pulsgenerator	NONIUS-DELFT

Voltage measurement: u
Capacitive divider : C_H= 162.5 pF, C_N= 1.313 µF
AC Peak Voltmeter Haefely type 51
Oszilloskop Tektronix Typ 2430

Test sample : Complete surge arresters